# WILL SELECTION FOR DECREASE FAECAL WORM EGG COUNT RESULT IN AN INCREASE IN SCOURING?

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## SUMMARY

Heritabilities of, and the genetic and phenotypic correlations between clean fleece weight (CFW), fibre diameter (FD), staple strength (SS), body weight (BWT), faecal worm egg count (FWEC) and faecal consistency score (FS) were estimated in an unselected Merino flock. These parameters were used to predict the correlated genetic responses in these traits to different degrees of selection on FWEC. The results suggest that in a Mediterranean environment, the genetic gains in CFW will probably decline but the gains in scouring and BWT will stay relatively constant with increasing amounts of selection pressure on FWEC.

**Keywords:** Worm resistance, scouring, genetic relationships, wool traits

## INTRODUCTION

Scouring is a major economic and farm management problem in the Merino industry in Australia. It results in faecal soiling of wool ("dags") which reduces wool value and increases costs due to crutching. It also predisposes sheep to blowfly breach strike that can result in deaths and production losses. Chemical treatments to prevent blowfly strike contribute to high pesticide residues in wool.

Two types of scouring due to gastro-internal parasites are recognised. Firstly, high faecal worm egg count (FWEC) scouring due to a high adult worm burden. This is seen in young and mature sheep unable to mount an effective immune response. Secondly, low FWEC scouring (hypersensitivity) due to the intake of L3 larvae from gastro-intestinal nematodes, especially *Trichostrongylus*, *Ostertagia* and *Nematodirus* spp. (Larsen *et al.* 1995). The latter type is generally seen in immunologically competent sheep especially in the winter rainfall regions of Australia.

Recently, Greeff and Karlsson (1998) found an unfavourable relationship between scouring as measured by faecal consistency (FS) and faecal worm egg counts (FWEC), clean fleece weight (CFW), fibre diameter (FD), hogget body weight (BWT), staple strength (SS), coefficient of variation of fibre diameter (CVFD) in the Rylington Merino Flock. The line selected for low FWEC also had a higher ($P<0.10$) propensity to scour than the unselected control flock (Karlsson *et al.* 1995). Similar findings have also been reported by Douch *et al* (1995) and Morris *et al* (1997) who found that a line of Romney sheep that were selected for low FWEC, had significantly more dags than an unselected line. This raises concern whether selection for low FWEC and increased production will result in an increase in scouring. If this should be the case it could jeopardise the uptake of technology to breed sheep for increased resistance to worms. Both the above mentioned studies were carried out when selection was specifically for low FWEC, but it is not clear what the consequences might be in a multi-trait selection program.

## MATERIAL AND METHODS

This study was undertaken to study the relationship between FWEC, FS and the fleece and body weight traits in a flock of unselected Merino hoggets (± 16 months of age) in south-western WA. The flocks were described by Lewer *et al* (1992).

**Data analysis.** CFW, FD, BWT, SS, CVFD, FWEC and FS (1 = hard pellets to 10 = fluid faeces) measured at hogget age, were available on 3665 Merino hoggets, born between 1994 and 1997. They were the progeny of 165 rams and complete pedigrees were available.

The data were analysed with the ASREML computer program (Gilmour *et al.* 1997). FWEC were transformed to cube roots (Woolaston and Piper 1997) and FS scores were transformed to logarithms to normalise the data. An animal model was fitted with year of birth, sex, birth status, age of dam and management group as fixed effects. A maternal genetic effect and a permanent maternal environmental effect were also fitted but were found to be significant only for BWT. The genetic and phenotypic variances and covariances obtained were used to predict the responses to index selection with the SELIND computer program (Cunningham 1970).

## RESULTS AND DISCUSSION

**Genetic parameters.** Estimates of heritabilities of, and genetic and phenotypic correlations between the traits are shown in Table 1. The heritability estimates of CFW, FD, CVFD, SS and BWT agree well with the generally accepted Rampower estimates (Lindsay Brash, pers. comm.) The heritability estimates of FWEC and FS in this flock were generally lower than previously reported (Greeff and Karlsson, 1997) but agree well with the estimates found in the Rylington selection line (Greeff and Karlsson, 1998). The phenotypic correlations between CFW, FD and BWT were generally higher whereas the genetic relationships of CVFD, SS and FWEC with CFW, FD and BWT appeared to be more variable than those reported previously. Estimates of the genetic correlations between FWEC and CFW ($r_g$ = 0.10), and between FWEC and FD ($r_g$ = 0.17) were low but positive which is in the opposite direction to the pooled estimate ($r_g$ = -0.12 and -0.12 respectively) at 16 months of age in a number of studies reported by Eady *et al* (1998).

**Correlated responses for selection for low FWEC.** The annual genetic responses (%) in CFW, BWT, FD, SS and FS to index selection incorporating different amounts of selection emphasis on FWEC were predicted using the genetic parameters from Table 1. The genetic responses from one standard deviation of selection on an index are indicated in Figure 1. The initial breeding objective was to reduce FD by one micron, maximise CFW and to maintain BWT over 10 years. The annual genetic responses have been expressed as a percentage of the assumed mean for each trait (CFW = 3.5 kg; FD = 21 micron, SS = 30 N/ktex; BWT = 55 kg; FS = 2.5).

**Table 1. Heritability estimates (on diagonal) of, and genetic (below diagonal) and phenotypic (above diagonal) correlations between body weight, fleece traits, FWEC and FS**

| | CFW | BWT | FD | CVFD | SS | FWEC | $Log_e$ FS |
|---|---|---|---|---|---|---|---|
| **Phenotypic variance** | 0.30 (kg) | 36.45 (kg) | 2.31 (μm) | 8.84 (%) | 60.77 (N/ktex) | 8.32 $epg^{0.33}$ | 0.10 |
| **CFW** | **0.35** | 0.37 | 0.23 | 0.03 | 0.11 | 0.01 | 0.02 |
| ± *se* | *0.05* | *0.02* | *0.02* | *0.02* | *0.02* | *0.03* | *0.02* |
| **BWT** | 0.22 | **0.32** | 0.16 | -0.17 | 0.05 | -0.08 | 0.07 |
| ± *se* | *0.09* | *0.05* | *0.02* | *0.02* | *0.02* | *0.02* | *0.02* |
| **FD** | 0.37 | 0.14 | **0.57** | -0.16 | 0.24 | 0.01 | 0.00 |
| ± *se* | *0.08* | *0.08* | *0.05* | *0.02* | *0.02* | *0.02* | *0.02* |
| **CV** | 0.04 | -0.08 | -0.14 | **0.54** | -0.40 | 0.09 | 0.04 |
| ± *se* | *0.09* | *0.09* | *0.07* | *0.05* | *0.02* | *0.03* | *0.02* |
| **SS** | 0.10 | -0.10 | 0.31 | -0.55 | **0.36** | -0.03 | -0.07 |
| ± *se* | *0.10* | *0.09* | *0.07* | *0.06* | *0.05* | *0.03* | *0.02* |
| **FWEC** | 0.10 | -0.08 | 0.17 | -0.05 | 0.13 | **0.15** | -0.04 |
| ± *se* | *0.16* | *0.15* | *0.13* | *0.14* | *0.15* | *0.04* | *0.10* |
| **$Log_e$ FS** | -0.04 | 0.17 | -0.10 | -0.02 | -0.24 | 0.10 | **0.13** |
| ± *se* | *0.13* | *0.13* | *0.11* | *0.12* | *0.12* | *0.20* | *0.03* |

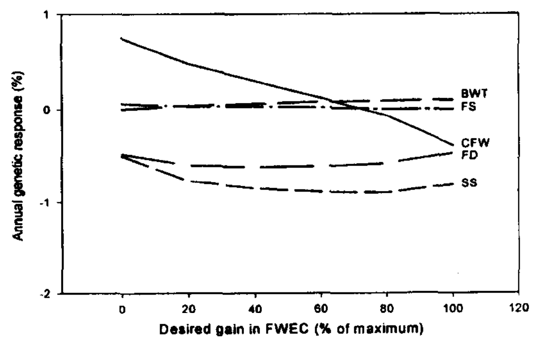


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**Figure 1. Annual genetic responses in body weight, wool traits (CFW, FD, SS) and FS with different amounts of selection emphasis on FWEC.**

Figure 1 indicates that with no selection emphasis on FWEC the annual genetic gain in CFW will be 0.75 %, -0.48 % for FD, -0.5 % for SS, with virtually no change in BWT and FS. As more emphasis is put on FWEC, the gains in CFW reduce to a loss of 0.39 % per year when all the emphasis is on FWEC. This is probably due to the positive genetic relationship ($r_g$=0.10) estimated between CFW and FWEC in this study. BWT and FS will both improve, but only very slightly. The annual gains in FD will be slightly better (-0.6 %) with 20 % emphasis on FWEC after which the gains stayed relatively constant up to 80 % emphasis on FWEC. The annual gains will drop back to –0.47 % when selecting solely on FWEC. SS followed the same pattern but with a larger decrease of up to 0.9 % at 80 % selection emphasis after which the loss drops back to 0.8 % with 100 % selection emphasis on FWEC. The large drop in SS is mainly due to the unfavourable genetic relationship between SS and FD and indicates again that SS should be included in the breeding objective to counter these losses if the aim is to reduce FD.

The results from this study indicate that selection for low FWEC in this environment should not result in an increase in scouring in the initial stages of selection and should not deter breeders from including breeding for worm resistance in their breeding programs. However, the unfavourable relationship between FWEC and scouring in the other studies can not be ignored because it suggests that other environmental factors, which determine the level of worm challenge, may affect this relationship. Until further information becomes available on the relationship between FWEC and scouring it is proposed that they should be treated as two independent traits. More work needs to be done to differentiate between low FWEC scouring and high FWEC scouring in the winter rainfall regions.

**REFERENCES**

Cunningham, E.P. (1970) SELIND Users Guide. An Foras Taluntais, Dunsinea, Castleknock, Dublin, Ireland

Douch, P.G.C., Green, R.S., Morris, C.A., Bisset, S.A., Vlassoff, A., Baker, R.L., Watson, T.G.,Hurford, A.P. and Wheeler, M. (1995) *Livest. Prod. Sci.* **41**: 121

Eady, S.J., Woolaston, R.R., Lewer, R.P., Raadsma, H.W., Swan, A.A. and Ponzoni, R.W. (1998) *Aust. J. Agric. Sci.* **49**:1201

Gilmour, A.R., Thompson, R., Cullis, B.R., Welham, S.J. (1997) ASREML manual, NSWAgriculture, Orange

Greeff, J.C. and Karlsson, L.J.E. (1997) *Proc. Assoc. Advmt. Anim. Breed. Genet.* **12**:333

Greeff, J.C. and Karlsson, L.J.E. (1998) *Proc. 6th World Congr. Gen. Appl. Livest. Prod.* **24**:63.

Karlsson, L.J.E., Greeff, J.C. and Harris, J.F. (1995) *Proc. Aust. Ass. Anim. Breed. Genet.* **11**:122

Larsen, J.W.A., Vizard, A.L., Webb Ware, J.K., Anderson, N. (1995) *Aust. Vet. J.* **72**:196

Lewer, R.P., Woolaston, R.R. and Howe, R.R.(1992) *Aust. J. Agric. Res.* **43**:1381

Morris C.A., Vlassoff, A., Bisset, S.A., Baker, R.L., West, C.J. and Hurford, A.P. (1997) *Anim. Sci.***64**:319

Woolaston, R.R. and Piper, L.R. (1997) *Anim. Sci.* **62**:451